

Relationships between Meteorological Conditions and Cloud Properties Determined From ARM Data

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Improvements of cloud model parameterizations require basic knowledge of the relationships between measured and modeled meteorological state parameters and the cloud properties in a given volume of air. The uncertainty in the relationships, especially large for cirrus clouds, is exacerbated by the differences between actual soundings and those produced by analyses and by differences in the actual and retrieved cloud properties. With the availability of high temporal and spatial resolution analyses and satellite cloud retrievals, it is imperative to better understand those relationships. This paper examines the statistical dependencies of various cloud properties, beginning with cloud amount, on the temperature, relative humidity, and horizontal and vertical winds. Data from balloon soundings (BBS) and surface-based retrievals (SBR, e.g. ARSCL) over the ARM SGP central facility, from the Rapid Update Cycle (RUC), and from the ARM satellite analyses (GOES) are used in this study. A reference set of statistics describing the dependence of cloud properties on state variables is generated from the BBS and SBR data since they provide the most detailed and accurate characterizations. Similar statistics are generated using the BBS and GOES data, the SBR and RUC data, and the GOES and RUC data. Differences in these various statistics provide a measure of the uncertainties in relationship derived from similar datasets. Comparisons of the RUC-generated and GEOS cloud cover will also be examined to determine the differences in the predicted and observed cloud properties. The statistical dependencies will then be used to help interpret the differences. The results of this study should be valuable for improving cloud parameterizations and for development of improved methods for validating model-generated cloud cover.